Herbage and protein productivity of single or intercropped alfalfa and bromegrass under zero nitrogen fertilization.

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Nitrogen (N) fertilizer enhances the growth of grass in grass-legume associations and frequently inhibits N_2 fixation by the legume-*Rhizobium* symbiosis. The cost of N fertilizer and environmental concerns related to contamination of groundwater make the use of N fertilizers a less attractive alternative. The herbage and crude protein production of single or intercropped alfalfa (*Medicago sativa* cv. Beaver) and meadow bromegrass (*Bromus riparius* Rhem. cv. Fleet) grown under irrigation, without N-fertilization, were evaluated near Outlook, Saskatchewan, from 1990 to 1992. Hay yield of alfalfa increased from 4.5 t ha^{-1} in the first year to 10.6 t ha^{-1} in the third year following seeding. The hay yield of bromegrass decreased from 5.3 t ha^{-1} in the second year to 1.2 t ha^{-1} in the following year due to limited availability of N for plant growth. Alfalfa+bromegrass hay yield increased from 4.1 t ha^{-1} in the first year to 10.5 t ha^{-1} in the third year. Crude protein yields of single alfalfa or alfalfa+bromegrass were above 750 kg ha^{-1} $year^{-1}$ in the first year and increased to 1700 kg ha^{-1} $year^{-1}$ in the third year whereas the crude protein yield of bromegrass declined from 300 kg ha^{-1} in the first year to 80 kg ha^{-1} in the third year. Crude protein yield bromegrass seeded in alternate rows with alfalfa was up to 25 % higher than that of single bromegrass (not sharing resources). The amount of nitrogen fixation (kg ha^{-1}) on intercropped alfalfa in the third year was as high as that of alfalfa not sharing space with bromegrass.

INTRODUCTION

Nitrogen fertilizer enhances the growth of grass in grass-legume associations and frequently inhibits N_2 fixation by the legume-*Rhizobium* symbiosis. In addition the cost of N fertilization and environmental concerns related to contamination of groundwater, especially on irrigated land, makes the use of N fertilizers a less attractive alternative.

The objectives of this work were: 1) verify the herbage and crude protein productivity of single or intercropped alfalfa and bromegrass under irrigation, without N-fertilization, and 2) verify the relation between the obtained productivity and the most relevant parameters involved in the plant N nutrition: soil mineral N and N_2-fixation.

MATERIAL AND METHODS

Single or intercropped alfalfa cv. Beaver and meadow bromegrass cv. Fleet were seeded on May 23, 1990 at the Saskatchewan Irrigation Development Center-SIDC near Outlook, SK. The swards were managed as hay crops and fertilized with 20 kg of P ha^{-1} before seeding and with 44 kg of P ha^{-1} plus 436 kg of K ha^{-1} on July 12, 1991. Plots were laid out as a Randomized Complete Block Design with four replicates. Forages were clipped at 9 cm above ground

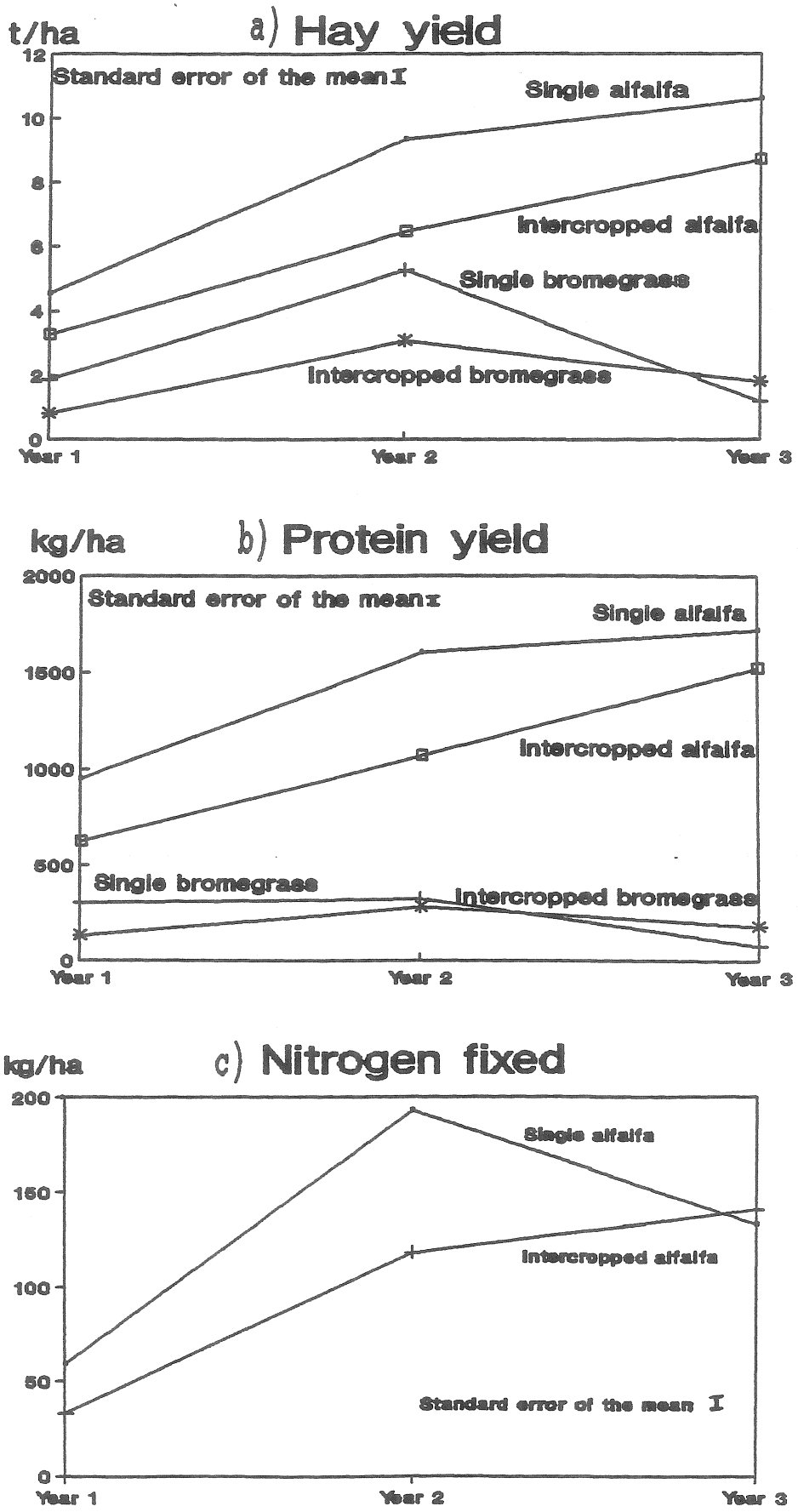

Figure 1. a) Hay, b) crude protein yield and c) nitrogen fixed by forages grown under irrigation, without N-fertilization, from 1990 to 1992.

(1990 until 1992), on 4 m^2, analyzed for N by the micro-Kjeldahl method and for $\delta^{15}N$ on a VG Micromass 602E mass spectrometer.

RESULTS AND DISCUSSION

The analysis of these results should consider that intercropped alfalfa and bromegrass were sharing space and competing for resources such as soil N, moisture and light.

Alfalfa + bromegrass hay and protein yield increased from the first to the third year and were similar to the yield of alfalfa grown alone (Fig. 1a and 1b). Intercropped alfalfa in the third year fixed equal amounts of N_2 as single alfalfa (Fig. 1c). Hay yield (Fig. 1a) and protein yield (Fig. 1b) of bromegrass decreased from the second to the following year due to limited availability of N for plant growth. Crude protein yield of bromegrass seeded in alternate rows with alfalfa was up to 25 % higher than that of single bromegrass (Fig. 1b).

Plant available N in the soil (data not presented) dropped from 40 µg.g of $soil^{-1}$ before seeding to less than 10 µg.g of $soil^{-1}$ by the fall of the establishment year and remained below 10 µg.g of $soil^{-1}$ for all treatments indicating that N was incorporated in plants and/or immobilized by microorganisms.

CONCLUSIONS

The forage and crude protein yield of either single or intercropped bromegrass was lower than that of alfalfa due to its dependence on limited soil N supply. The results of the third year suggest that higher hay and protein yields can be expected from intercropped as compared to single bromegrass following full establishment of the swards.

The higher hay and crude protein yield of intercropped bromegrass compared to single cropped bromegrass in the third year is probably due to transfer of symbiotically fixed N to the grass.

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